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Who is More Expressive During Child-Robot Interaction: Pakistani or Dutch Children?

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ABSTRACT
In this study we have tried to determine if the cultural background of children has an influence on how they interact with robots. Children of different age groups and cultures played a card guessing game with a robot (iCat). By using perception tests to evaluate the children's emotional response it was revealed that children from South Asia (Pakistani) were much more expressive than European children (Dutch) and younger children were more expressive than the older ones in the context of child robot interaction.

Categories and Subject Descriptors
H.5.2 [**User Interfaces**]: *prototyping, evaluation /methodology.*

General Terms
Design, Experimentation, Human Factors

Keywords
Robot, children, culture, games, age

1. INTRODUCTION
Our research was initiated to study several questions, such as: 1) would a general extrovertness in facial expressions also be seen while interacting with an unknown entity such as a robot, 2) are children from different cultural backgrounds equally comfortable while interacting with a robot and how the social interaction with robots varies across cultures, and 3) how children of different age groups emotionally respond to a robot during a winning and loosing situation in a game. There has been research done to study the role of cultural background on the perception of (interaction with) robots [1,2] but most of these studies are done with adults [3] and relatively less attention is paid on the emotional and non-verbal response of participants towards robots.

2. Method
2.1 Game Design
We used a card guessing game [4] as a tool for investigating the influence of a robot's presence as a game partner on the game and social experience of children. At the start of the game, players see a row of 6 cards on a computer screen, five of which are turned upside down, and only the number on the first card can be seen. The numbers on the cards are all between 1 and 10 and every number can only appear once within a game. Players have to guess whether the next card in the row will contain a higher or a lower number. After guessing whether the next number will be higher or lower, the relevant card is turned around. Players receive feedback on the correctness or incorrectness of their choice via a characteristic non-speech audio sound (booing or clapping). As soon as participants make a wrong guess the game is over. Participants win the game if they predict all cards correctly. During the experiment, each child played six games. However, unknown to the children, each game was completely deterministic, and two different game alternatives were used. In the first alternative, a rational decision procedure would result in winning the game, and in the second alternative, being rational would result in losing the game. Winning and losing games were mixed in the sequence (3 each).

2.2 Interaction with the Robot
The iCat, a social robot, was used as a game partner for children, who had to make their higher-or-lower guess together with the iCat. We used a Wizard of Oz method to simulate both the verbal and non-verbal behavior of the iCat. The wizard was located outside of the child's field of vision. Pakistani children interacted with the iCat in Urdu (National Language) and Dutch children interacted with the iCat in Dutch.

2.3 Participants
In total, 100 children played the game of which 48 children were Pakistani who played the game with iCat in Pakistan and 52 children were Dutch who played the game with iCat in the Netherlands. In both cultures, half of the children were approximately 8 years old (group 4 in the Dutch elementary school system and class 2 in Pakistani school system) and the other half around 12 years old. We balanced gender for both age groups. Parents gave prior written consent for their child's participation and video recording.

2.4 Procedure
The experiment was conducted in two elementary schools in Tilburg (the Netherlands) and one elementary school in Lahore (Pakistan). The procedure for both conditions (Pakistani players and Dutch players) was the same. A separate room was used in all schools, where children were seated on a chair placed in front of a table with a computer screen displaying the game. A video camera was placed on top of the screen and recorded the child's face, upper body and full body of iCat. In all cases, children sat next to the iCat and the iCat was positioned in such a way that by turning its head it could look both at the screen and the child, allowing for eye contact (see figure 1). Half of the children were positioned at the right side of the iCat, and half at the left. After entering the

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room, the children were first informally introduced to the iCat, after which the game was explained to them.

Figure 1: Pakistani 8 year old touching iCat after loosing (L), Dutch 8 year old boy arguing with iCat (R)

Next, the children played a practice trial together with the iCat, while the experimenter was still in the room to answer any possible questions. When the practice session was over, the experimenter left the child's field of vision and started the game. After six games, the experimenter guided the child back to the first room where the child had to fill in a post-questionnaire. The experimenter and iCat were outside the child's view when they were filling in the questionnaire to avoid presence effects. Next, the experimenter asked the children some open questions, and rewarded the children with a gift.

3. MEASUREMENT: PERCEPTION TEST

3.1 Stimuli

We randomly selected 80 children (40 Dutch and 40 Pakistani with balanced for age and gender) for inclusion in the perception test. For each child, we cut the response to their second winning game (in which children together with iCat made a correct prediction for the last card) and second losing game (in which the final guess turned out to be incorrect) from the video recordings. In all cases we zoomed in on the child's face; the iCat was never visible in the stimuli. The video snippets were cut from the moment the final card was turned to when their primary response was finished. This resulted in 80 Dutch stimuli [= 10 (8 year old boys) + 10 (8 year old girls) + 10 (12 year old boys) + 10 (12 year old girls) x (1 win + 1 lost)] and 80 Pakistani stimuli (similar manner). Stimuli were presented to judges in a random order, and in a vision-only format to avoid participants from relying on auditory cues such as "Yahooo!".

3.2 Participants

Two group experiments were conducted. One group of 35 participants with roughly equal numbers of men and women rated the Pakistani stimuli and another group of 35 participants rated the Dutch stimuli.

3.3 Procedure

The procedure for both group experiments was essentially the same. Participants were invited into a quiet classroom where the computer screen was projected on the classroom wall using a beamer. Participants were told that they would see 80 stimuli showing children who just found that either won or lost a game, and that that their task was to determine whether the children had won or lost. They were also asked to rate the emotional expressiveness of each child on a 7 point Likert scale, where 1 stood for "not expressive at all" to 7 was "extremely expressive". Each stimulus was preceded by a number displayed on the screen indicating the upcoming stimulus, and the stimulus was followed by a six second pause during which participants could fill in their scores on the answer form. The actual experiment was preceded by a short training session in which 3 clips were shown (different from the ones shown in the actual experiment) to make participants familiar with the stimuli and the experimental task. If everything was clear, the actual experiment started which lasted for approximately 19 minutes for Dutch stimuli and 23 minutes for Pakistani Stimuli. During the experiment there was no interaction between participants and experimenter.

4. RESULTS AND DISCUSSION

The analyses are still in progress. In this late breaking results paper, we will briefly report the type of analysis and few results from the perception test. All tests for significance were performed using a repeated measurements ANOVA with three 'within-participants' factors: *Age group* (levels: 8 years old, 12 years old), *Gender* (levels: boy, girl), and *culture* (levels: Pakistani, Dutch) and with percentage of correct classification as the dependent variable. The assumption is that when children are more expressive, judges will be more frequently correct in their classification.

Early results show that the percentage of correct classification is higher for Pakistani children than for Dutch children. It means that Pakistani children were more expressive while interacting with iCat and it was easy for judges to notice this by looking at children's facial expressions. The percentage of correct classification was higher for 8 year old children than for 12 year old children for both cultures (Pakistani and Dutch). Pakistani 8 year old were the most expressive ones in both winning and losing situations. Dutch 8 year old were more expressive while losing a game as compare to winning to the game. In terms of interaction with iCat, both 8 and 12 year old Pakistani children sat in close proximity of the iCat and the conversation with iCat was relatively long. In the case of Dutch children, the conversation between iCat and children was relatively short and especially in the case of 12 year old Dutch children, it was quite minimalistic.

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